

DETAIL SPECIFICATION

SWITCHES, RADIO-FREQUENCY TRANSMISSION LINE,
(COAXIAL), GENERAL SPECIFICATION FOR

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the general requirements for coaxial switches, either manually or remotely controlled, for use with coaxial cable at radio frequencies.

1.2 Classification. Coaxial switches are of the following classes (see 6.2):

<u>Class</u>	<u>Type of RF connector</u>
1	N
4	TNC
5	SMA and 3.5 mm
7	BNC

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

DEPARTMENT OF DEFENSE

MIL-DTL-5015	-	Connectors, Electrical, Circular Threaded, AN Type, General Specification For.
MIL-C-5541	-	Chemical Conversion Coatings on Aluminum and Aluminum Alloys.
MIL-A-8625	-	Anodic Coatings For Aluminum and Aluminum Alloys.

Comments, suggestions, or questions on this document should be addressed to Defense Supply Center Columbus, ATTN: DSCC-VAT, P.O. Box 3990, Columbus, OH 43216-5000, or e-mailed to TubesFiberOptic@dla.mil. Since contact information can change, you may want to verify the currency of this address information using ASSIST Online database at www.dodssp.daps.mil.

MIL-DTL-3928F

MIL-F-14072	-	Finishes for Ground Based Electronic Equipment.
MIL-PRF-19500	-	Semiconductor Devices, General Specification for.
MIL-M-38510	-	Microcircuits, General Specification For.
MIL-DTL-38999	-	Connectors, Electrical, Circular, Miniature, High Density, Quick Disconnect (Bayonet, Threaded, and Breech Coupling) Environment Resistant, Removable Crimp and Hermetic Solder Contacts, General Specification For.
MIL-PRF-39012	-	Connectors, Coaxial, Radio Frequency, General Specification For.
MIL-C-83723	-	Connectors, Electrical, (Circular, Environment Resisting), Receptacles and Plugs, General Specification For.

(See supplement 1 for list of specification sheets.)

STANDARDS

FEDERAL

FED-STD-H28	-	Screw-Thread Standards for Federal Services.
-------------	---	--

DEPARTMENT OF DEFENSE

MIL-STD-202	-	Test Method Standard Electronic and Electrical Component Parts.
MIL-STD-810	-	Environmental Engineering Considerations and Laboratory Tests.
MIL-STD-889	-	Dissimilar Metals.
MIL-STD-1285	-	Marking of Electrical and Electronic Parts.

(Copies of these documents are available on line at <http://assist.daps.dla.mil/quicksearch/> or www.dodssp.daps.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, issues of these documents are those cited in the solicitation or contract (see 6.2).

ASTM INTERNATIONAL (ASTM)

ASTM-A582/A582M	-	Free-Machining Stainless Steel Bars (DoD adopted).
ASTM-B16/B16M	-	Rod, Free-Cutting Brass, Bar and Shapes for Use in Screw Machines (DoD adopted).
ASTM-B26/B26M	-	Aluminum-Alloy Sand Castings (DoD adopted).
ASTM-B36/B36M	-	Plate, Brass, Sheet, Strip, and Rolled Bar (DoD adopted).
ASTM-B85	-	Aluminum-Alloy Die Castings (DoD adopted).
ASTM-B108	-	Aluminum-Alloy Permanent Mold Castings (DoD adopted).
ASTM-B121/B121M	-	Plate, Leaded Brass, Sheet, Strip, and Rolled Bar (DoD adopted).
ASTM-B124	-	Copper and Copper alloy Forging Rod, Bar, and Shapes (DoD adopted).
ASTM-B194	-	Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar (DoD adopted).
ASTM-B196	-	Rod and Bar, Copper-Beryllium Alloy (DoD adopted).
ASTM-B197/B197M	-	Copper-Beryllium Alloy Wire (DoD adopted).
ASTM-B211	-	Aluminum and Aluminum-Alloy Bar, Rod, and Wire (DoD adopted).
ASTM-B339	-	Pig Tin (DoD adopted).
ASTM-B488	-	Gold for Engineering Uses, Electrodeposited Coatings of (DoD adopted).
ASTM-B545	-	Tin, Electrodeposited Coatings of (DoD adopted).
ASTM-B700	-	Electrodeposited Coatings of Silver for Engineering Use.
ASTM-G21	-	Materials to Fungi, Synthetic Polymeric, Determining Resistance of (DoD adopted).

(Copies of these documents are available from ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 or www.astm.org.)

SAE INTERNATIONAL (SAE) AEROSPACE MATERIALS SPECIFICATIONS (AMS)

AMS-C-26074	-	Coatings, Electroless Nickel, Requirements for (DoD adopted).
AMS-QQ-A-200	-	Aluminum Alloy, Bar, Rod, Shapes, Structural Shapes, Tube and Wire, Extruded: General Specification For (DoD adopted).
AMS-QQ-A-220/9	-	Aluminum Alloy 6063, Bar, Rod, Shapes, Tube, and Wire, Extruded (DoD adopted).
AMS-QQ-A-225	-	Aluminum and Aluminum Alloy, Bar, Rod, Wire, or Special Shapes; Rolled, Drawn, or Cold Finished; General Specification For (DoD adopted).
AMS-QQ-A-225/3	-	Aluminum Alloy, Bar, Rod, and Wire, Rolled, Drawn, or Cold Finished, 2011 (DoD adopted).
AMS-QQ-A-250	-	Aluminum and Aluminum Alloy, Plate and Sheet, General Specification For. (DoD adopted).
AMS-QQ-A-250/1	-	Aluminum 1100, Plate and Sheet (DoD adopted).
AMS-QQ-A-250/5	-	Aluminum Alloy ALCAD 2024, Plate and Sheet (DoD adopted).
AMS-QQ-A-250/8	-	Aluminum Alloy 5052, Plate and Sheet (DoD adopted).
AMS-QQ-A-250/11	-	Aluminum Alloy 6061, Plate and Sheet (DoD adopted).
AMS-QQ-S-763	-	Steel Bars, Wire, Shapes, and Forgings; Corrosion-Resistant (DoD adopted).
AMS 2422	-	Plating, Gold.

(DoD activities may obtain copies of these publications from Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094 or www.dodssp.daps.mil. Copies of these documents are available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or www.sae.org.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between the requirements of this specification and of the specification sheet, the latter shall govern.

3.2 Qualification. Switches furnished under this specification shall be products which are qualified for listing on the applicable qualified products list at the time set for opening of bids (see 4.4 and 6.3).

3.3 Materials. Materials shall be as specified herein and in the applicable specification sheets. When a definite material is not specified, materials shall be used which enable the switch to meet the performance requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guaranty of the acceptance of the finished product (see 4.2).

3.3.1 Brass. Brass shall conform to ASTM-B16/B16M, ASTM-B36/B36M, ASTM-B121/B121M or ASTM-B124.

3.3.2 Copper alloy. Copper alloy sheets shall conform to ASTM-B36/B36M or ASTM-B121/B121M.

3.3.3 Copper-beryllium. Beryllium-copper shall conform to ASTM-B194, ASTM-B196, ASTM-B197/B197M.

3.3.4 Aluminum alloy. Aluminum alloy sheets and plates shall conform to composition 2024 of SAE-AMS-QQ-A-250/5, composition 5052 of SAE-AMS-QQ-A-250/8, composition 6061 of SAE-AMS-QQ-A-250/11, or composition 1100 of SAE-AMS-QQ-A-250/1; extruded aluminum alloys shall conform to 6063 of SAE-AMS-QQ-A-200/9 or composition 6061 of SAE-AMS-QQ-A-250/11. Aluminum alloy castings shall conform to alloy 1360C of ASTM-B85, alloy SC70A of ASTM-B108, ZG61A of ASTM-B26/B26M or 2011 of SAE-AMS-QQ-A-225/3 and ASTM-B211.

3.3.5 Finishes. Unless otherwise specified, finishes shall be as specified in 3.3.5.1 through 3.3.5.3 (see 6.7 for guidance).

3.3.5.1 RF and power mating surfaces. Mating surfaces shall be finished in gold, nickel, silver, tin, or passivate conforming to AMS-2422, ASTM-B488, SAE-AMS-QQ-A-225 and ASTM-B211, type 1, grade C, class 1, SAE-AMS-C-26074, ASTM-B700, ASTM-B545 or ASTM-B339. The minimum thickness for gold and nickel plating shall be 10 microinches and 20 microinches, respectively. Passivated steel surfaces shall be anodized in accordance with MIL-A-8625. Nickel plating should be used only when other plating will not meet performance requirements.

3.3.5.2 External surfaces. All external surfaces, except RF and power mating surfaces that are not electroplated, shall be anodized in accordance with MIL-A-8625, type II, class 2, chemical conversion coated in accordance with MIL-C-5541, class 3, electroless nickel-plated, or painted with a semi-gloss or dull black enamel finish in accordance with type II of MIL-F-14072. Nickel plating should be used only when other plating or processes will not meet performance requirements.

3.3.5.3 Aluminum alloys. Aluminum alloy surfaces shall be nickel-plated, gold-plated, silver-plated, anodized in accordance with MIL-A-8625, type II, class 2, or chemically treated in accordance with MIL-C-5541, class 3. Nickel plating should be used only when other plating will not meet performance requirements. When surfaces are chemically treated, the RF and power mating surfaces shall be conductive.

3.3.6 Dissimilar metals. Unless suitably protected against electrolytic corrosion, dissimilar metals (see MIL-STD-889) shall not be used in intimate contact with each other. Dissimilar metals are defined as metal specimens that are in contact or otherwise electrically connected to each other in a conductive solution and that generate electric current.

3.3.7 Fungus inert. Materials used in the construction of switches herein shall be fungus inert in accordance with ASTM-G21. Fungus inert material is defined as a material which, in all modified states and grades, is not a nutrient to fungi.

3.4 Interface and physical dimensions. Coaxial switches shall be of the interface and physical dimensions specified (see 3.1).

3.4.1 General. Any military specification, or standard referred to in this specification may be replaced by an equivalent commercial standard after receiving approval from the preparing activity.

3.4.2 Operation. Switches shall be either electrically or manually operated and identified (see 3.1) as follows:

- a. Manually controlled - M.
- b. Remotely controlled (RC) - R.
 - (1) Solenoid - S.
 - (a) Fail-safe - F.
 - (b) Latching - L.
 - (2) Motor - M.
- c. Logic - Lo.

3.4.3 Configuration. Switches shall be furnished with the number of positions specified (see 3.1).

3.4.4 Sequence. Unless otherwise specified, switch RF circuit contacts shall have a break-before-make sequence of operation (see 6.2).

3.4.5 Termination. Switches shall be supplied with their off-circuit output terminals open (o), grounded (g), or terminated in a resistor (r) as specified (see 3.1). Unless otherwise specified (see 6.2), terminal resistors shall be a nominal 50 Ω , 0.5 watt resistor.

3.4.6 Nominal impedance. Nominal impedance of the switch shall be as specified (see 3.1).

3.4.7 Duty cycle. Unless continuous duty is specified, switches shall be capable of intermittent switching actions only (see 6.2 and 6.4.13).

3.4.8 Threaded parts. All external threaded parts shall have screw threads in the unified screw thread series in accordance with FED-STD-H28 and supplements thereto. Tapped holes in aluminum housings specifically provided for mounting of the switches shall be provided with inserts to assure adequate thread strength and life.

3.4.9 Connectors. All connectors shall have their metallic shells grounded to the switch metallic casing.

3.4.9.1 Radio frequency (RF) connectors. Connectors for a specific switch shall be as specified (see 3.1). All RF connectors shall meet mating and material requirements of MIL-PRF-39012.

3.4.9.1.1 RF connector metal parts. Unless otherwise specified, the male center contact pins shall be captivated and made of corrosion-resisting steel or of beryllium copper. Corrosion-resisting steel pins shall be type 302 or type 304 in accordance with SAE-AMS-QQ-S-763, or type 303 in accordance with ASTM-A582/A582M. Beryllium copper pins shall conform to ASTM-B194, ASTM-B196, and ASTM-B197/B197M and shall be silver-plated in accordance with ASTM-B700 or gold-plated in accordance with AMS-2422 and ASTM-B488. The female center contact pins shall be captivated and made of beryllium copper conforming to ASTM-B194, ASTM-B196, and ASTM-B197/B197M and silver-plated in accordance with ASTM-B700 or gold-plated in accordance with AMS-2422 and ASTM-B488, with 99.0 percent gold (as a minimum) and 0.00005 inch thickness (as a minimum).

3.4.9.2 Power connectors. Unless otherwise specified, the power connectors shall conform to MIL-DTL-5015, MIL-DTL-38999, or MIL-C-83723.

3.4.9.3 Connector caps. All connectors shall be capped with push-on caps to prevent both damage and the entrance of moisture and foreign material during shipment or storage.

3.4.10 Diode suppression. When a diode is used for radio frequency (RF) noise suppression, it shall be protected by another diode such that applying a reverse polarity to the actuating circuit does not cause an excessive current to flow in the suppressing diode. Unless otherwise specified, all suppressing diodes shall be mounted inside the switch body.

3.4.11 Indicating circuits. When specified (see 6.2), remotely-controlled switches shall be equipped with separate contacts and terminals to operate a pilot light or other device which shall indicate the completed circuit in a single position switch or each position of a multiple position switch.

3.4.12 Housing. Switches shall be as identified below and as specified (see 3.1):

- a. Enclosed type (to exclude sand and dust) - (E).
- b. Hermetically sealed type - (H).
- c. Immersion-proof type - (I).
- d. Vented (for space applications) - (V).

3.4.13 Operating frequency range. The frequency range shall be as specified (see 3.1).

3.4.14 Temperature range. The temperature range shall be as specified (see 3.1).

3.4.15 Weight. The weight shall not exceed the limit specified (see 3.1).

3.4.16 Internal semiconductor devices. Semiconductor devices used within the switches shall conform to MIL-PRF-19500. A minimum of JANTX level parts shall be used for screened switches.

3.4.17 Internal microelectronic devices. Microelectronic devices used within the switches shall conform to MIL-M-38510.

3.5 Performance.

3.5.1 Screening. All screened switches produced to this specification shall be screened in accordance with table III (see 4.6.2).

3.5.2 Run-in. All switches produced to this specification shall be run-in in accordance with 4.6.3.

3.5.3 Voltage standing wave ratio (VSWR). When switches are tested as specified in 4.6.4, the VSWR at any port over the specified frequency range shall not exceed the value specified (see 3.1).

3.5.4 Insertion loss. When switches are tested as specified in 4.6.5, the insertion loss between ports of any continuous path over the specified frequency range shall not exceed the value specified (see 3.1).

3.5.5 Isolation. When switches are tested as specified in 4.6.6, the isolation between connected ports and the open ports over the specified frequency range shall be not less than specified (see 3.1).

3.5.6 RF power handling capability. When switches are tested as specified in 4.6.7, with rated power (see 3.1) passing through the switch, no evidence of breakdown, charring, or arcing shall be found. Following this test, insertion loss shall be no greater and isolation no less than the values specified (see 3.5.4 and 3.5.5 respectively). Unless otherwise specified (see 6.2), switches shall not be required to switch under power. When non-availability of test laboratory facility is demonstrated to the qualifying activity, the RF power handling capability requirement may be satisfied to the qualifying activity by technical records from system application(s) that quantify and benchmark the RF switch power handling performance and by use of system life performance guarantee. Qualifying activity approval is contingent upon review of quality history of manufacturers' switches in application systems.

3.5.7 Switching time (including contact bounce). When remotely-controlled sequentially operated switches are tested as specified in 4.6.8, the time required for switching to the first adjacent position reached in the direction of switching shall not exceed the time specified (see 3.1), except electric motor operated switches shall be allowed a 25 percent increase in switching time at the lowest temperature specified (see 3.1). When random position selection switches are tested as specified in 4.6.8, switching time shall be interpreted as time to switch to any other possible position, from every initial switch position.

3.5.8 Operating current and voltage. When remotely-controlled switches are tested as specified in 4.6.9, the following requirements shall be met:

- a. Unless otherwise specified (see 3.1), for each switch, for the voltage range that includes the specified (see 3.1) nominal operating voltage, when the applicable minimum operating voltage specified below is applied, the switch shall move into a selected position and make positive contact. When a pickup voltage requirement is specified (see 3.1) that is lower than the minimum required herein, the switch shall be tested and shown to operate at the specified pickup voltage.

<u>Minimum</u>	<u>Maximum</u>
4.5 V dc	5.5 V dc
9 V dc	14 V dc
20 V dc	30 V dc
38 V dc	54 V dc
99 V dc	121 V dc
103 V dc	127 V dc

- b. When the nominal operating voltage (see 3.1) is applied, the operating current shall not exceed that specified (see 3.1). Since operating current is dependent upon coil resistance (and thereby coil temperature and operating time), coil temperature during current measurement shall be kept between 20 deg C and 25 deg C, and the time required for current measurement shall be minimized.

- c. (Fail-safe switches only): Remotely-controlled solenoid switches shall return to the deenergized position when the activating voltage is reduced to the value of drop-out voltage as specified (see 3.1).

3.5.9 Operating force (manually controlled switches). When tested as specified in 4.6.10, switches shall operate smoothly. Accurate selection of an adjacent position shall be accomplished within two seconds. The force or torque required to actuate the switch shall be measured with an appropriate measuring device.

3.6 Dielectric withstanding voltage. When switches are tested as specified in 4.6.11, the switches shall withstand, without breakdown, the voltage specified in the applicable RF connector specification (see 3.4.9.1) applied for one minute between each pair of open RF connectors and between the center conductor and the shell of each RF connector. Each actuator and indicator terminal shall withstand the voltage (see 4.6.11) to the shell.

3.7 Insulation resistance. When switches are tested as specified in 4.6.12, the insulation resistance from case to any pin and between normally open pins shall be not less than that specified (see 3.1).

3.8 Transient interference (RFI). When specified, remotely-controlled switches shall be tested in accordance with 4.6.13 and shall not conduct RF noise to a degree greater than the following limiting values:

- a. DC switches +50 percent or -150 percent of nominal line voltage (28 V dc limit is ± 42 V peak).
- b. AC switches ± 2 times nominal rms line voltage (115 V ac limit is ± 230 V peak).

3.9 RF energy leakage. When switches are tested as specified in 4.6.14, the RF leakage from the switch shall be at least 65 dB below the incoming signal level.

3.10 Heat (fail-safe switches only). When tested as specified in 4.6.15, there shall be no sign of failure and the switching time shall be as specified (see 3.5.7). Any changes in the appearance of the switch or changes in the switching time - exceeding the value specified - shall be considered a failure.

3.11 Solderability (as applicable). When switches, or suitable "dummy units" with identical solderable connections as those of the switches herein, are tested as specified in 4.6.16, they shall meet the acceptable criteria of MIL-STD-202, method 208.

3.12 Resistance to soldering heat (as applicable). When switches with solderable connections are tested as specified in 4.6.17, there shall be no damage to the switches or to the terminal insulator that will cause electrical failure. Chipping of the terminal insulator shall not be cause for failure, unless the chipping extends to the outer periphery. After the test, the switching time of the switch shall not be greater than specified, and the operating current to the switch shall not exceed the maximum specified value.

3.13 Resistance to solvents. When switches are tested as specified in 4.6.18, the marking shall be legible at a distance of at least six inches with normal room lighting, and there shall be no visual evidence of mechanical damage or deterioration of materials or finishes under 3X magnification.

3.14 Terminal strength (as applicable). When switches with solder or screw terminals are tested as specified in 4.6.19, there shall be no evidence of broken terminals, elongations greater than one-half the thread pitch, or breakage, loosening, or relative motion between the terminals and switch body when viewed through a magnification of at least 10X. Any of these shall be considered a failure.

3.15 Thermal shock. When switches are tested as specified in 4.6.20, the switch shall be capable of reliable operation. Following the test, the switch shall meet the specified insertion loss, isolation, and switching time requirements. Any value that exceeds the specified requirement is a failure.

3.16 Altitude and cold. When switches are tested as specified in 4.6.21, there shall be no evidence of malfunction. During the test, the switch shall operate within the switching time specified (see 3.1) and withstand the dielectric withstanding voltage without breakdown. Switches that do not meet these requirements shall be considered failures.

3.17 Moisture resistance (applicable to types E and I only). When switches are tested as specified in 4.6.22, there shall be no evidence of breaking, cracking, spalling, or loosening of parts or insulation. Following the test, the switch shall meet the insertion loss, switching time, and dielectric withstanding voltage requirements. Switches that do not meet these requirements shall be considered failures.

3.18 Humidity (applicable to type E only). When switches are tested as specified in 4.6.23, there shall be no evidence of physical damage. Following the test, the switch shall meet the voltage standing wave ratio (VSWR) and the isolation requirements. Switches that do not meet these requirements shall be considered failures.

3.19 Sand and dust (applicable to type E only). When switches are tested as specified in 4.6.24, there shall be no evidence of sand and dust accumulation within the enclosure. Following the test, the switch shall meet the insertion loss and switching time requirements. Switches that do not meet these requirements shall be considered failures.

3.20 Immersion (applicable to type I only). When switches are tested as specified in 4.6.25, there shall be no leakage as evidenced by a continuous stream of bubbles. Following the test, the switch shall meet the insertion loss and switching time requirements. Switches that do not meet these requirements shall be considered failures.

3.21 Hermetic seal (applicable to type H only). When switches are tested as specified in 4.6.26, the leakage rate shall not exceed the applicable value specified below. The volume shall be computed using the external dimensions of the switch housing, disregarding any mounting (screws and stud).

<u>Sealed volume case</u>	<u>Maximum allowable leakage</u>
Greater than 2 cubic inches	10^{-6} atm cm ³ /sec
2 cubic inches or less	10^{-8} atm cm ³ /sec

3.22 Life cycle. When switches are tested as specified in 4.6.27, there shall be no evidence of physical damage or deterioration to the switch. Following the test, the switch shall meet the insertion loss, switching time, VSWR, and isolation requirements. Switches that do not meet these requirements shall be considered failures.

3.23 Explosion (applicable to remotely controlled types H and I only). When switches are tested as specified in 4.6.28, there shall be no explosion within the test chamber whether or not an explosion occurs within the switch. Following the test, the switch shall meet the insertion loss requirement. Switches that do not meet this requirement shall be considered failures.

3.24 Salt spray (corrosion) (applicable to types H and I only). When switches are tested as specified in 4.6.29, there shall be no evidence of warping, cracking, peeling, or corrosion that has passed through the surface finish and exposed the base metal, or any lead breakage when viewed through a magnification of at least 10X during visual inspection. Following the test, the switch shall meet the switching time requirement of 3.5.7. Switches that do not meet these requirements shall be considered failures.

3.25 Vibration. When switches are tested as specified in 4.6.30, there shall be no evidence of physical damage. Following the test, the switch shall meet the insertion loss and switching time requirements. Switches that do not meet all of these requirements shall be considered failures.

3.26 Acoustic noise (when specified, see 3.1). When switches are tested as specified in 4.6.31, there shall be no deterioration or change in tolerance limits of any internal or external parts of the switch. Following the test, the switch shall meet the VSWR and insertion loss requirements.

3.27 Shock (specified pulse). When switches are tested as specified in 4.6.32, there shall be no evidence of damage or loosening of parts on the switch. Following the test, the switch shall meet the insertion loss and switching time requirements. Switches that do not meet these requirements shall be considered failures.

3.28 Solar radiation (sunshine). When switches are tested as specified in 4.6.33, there shall be no evidence of jamming or loosening of moving parts, loss of seal integrity, premature actuation of electrical contacts, or blistering and peeling of paints and other finishes. During and after the test, the switch shall meet the isolation and switching time requirements.

3.29 Marking. Switches shall be marked in a legible and permanent manner, in accordance with MIL-STD-1285, with the following information.

- a. The military part or identifying number (PIN) (see 6.5).
- b. Manufacturer's source code or logo.
- c. Operating voltage and the frequency in the case of an ac supply for electromechanically operated switches.
- d. Date code.
- e. Serialization.

Terminals shall be marked in a logical manner to identify the input and output terminals. The marking characters shall be at least .0312 inch high. The marking shall remain legible after completing all environmental tests specified.

3.29.1 Date code. Switches shall be marked by a unique code to identify the period during which they were manufactured. The first two numbers in the code shall be two digits of the number of the year, and the third and fourth numbers shall be two digits indicating the calendar week of the year. When the number of the week is a single digit, it shall be preceded by a zero reading from left to right or top to bottom, the code number shall designate the year and week, in that order. The date code shall not be altered or removed from the switch.

3.29.2 Serialization. Each switch shall be marked with a unique serial number assigned consecutively within the inspection lot allowing traceability of the switch.

3.30 Workmanship. Switches shall be manufactured and processed in a careful and workmanlike manner, in accordance with good design and sound engineering and production practice, and to the requirements of this specification. The switch shall be free from tool marks, deep scratches, corrosion, and other defects that will affect life, serviceability, or appearance.

3.31 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to maximum extent possible provided the material meets or exceeds operational and maintenance requirements, and promotes economically advantageous life cycle costs. All components supplied shall be new and unused.

4. VERIFICATION

4.1 Classification of inspections. The inspections specified herein are classified as follows:

- a. Materials inspection (see 4.2).
- b. Qualification inspection (see 4.4).
- c. Conformance inspection (see 4.5).

4.2 Materials inspection. Materials inspection shall consist of certification supported by verifying data that the materials listed in table I, used in fabricating the switches, are in accordance with applicable requirements and specifications prior to such fabrication.

TABLE I. Materials inspection.

Material	Requirement paragraph	Applicable specification or reference document
Brass	3.3.1	ASTM-B16/B16M, ASTM-B36/B36M, ASTM-B121/B121M, ASTM-B124
Copper alloy	3.3.2	ASTM-B36/B36M, ASTM-B121/B121M
Copper beryllium	3.3.3	ASTM-B194, ASTM-B196, ASTM-B197/197M
Aluminum alloy	3.3.4	SAE-AMS-QQ-A-225/3, SAE-AMS-QQ-A-200/9, SAE-AMS-QQ-A-250/1, /5, /8, and /11, ASTM-B85, ASTM-B108, ASTM-B26/B26M, ASTM-B211
Finishes	3.3.5, 3.4.9.1.1	ASTM-B339, ASTM-B545, MIL-C-26074, MIL-A-8625, MIL-C-5541, QQ-S-365, MIL-F-14072, AMS-2422, ASTM-B488, SAE-AMS-QQ-A-225, ASTM-B211
Dissimilar metals	3.3.6	MIL-STD-889
Fungus inert	3.3.7	MIL-HDBK-454 (guideline 4)
Threaded parts	3.4.8	FED-STD-H28
Connectors	3.4.9	MIL-PRF-39012, MIL-DTL-5015, MIL-DTL-38999, MIL-C-83723, SAE-AMS-QQ-S-763, ASTM-A582/A582M
Semiconductor devices	3.4.16	MIL-HDBK-454 (guideline 30)
Microelectronic devices	3.4.17	MIL-HDBK-454 (guideline 64)

4.3 Inspection conditions. Unless otherwise specified herein, all inspections shall be performed in accordance with the test conditions specified in the "GENERAL REQUIREMENTS" of MIL-STD-202.

4.3.1 Test method or test setup variation. Variation from the specified test methods or setups used to verify the electrical, mechanical, or environmental parameters are allowed provided that it is demonstrated to the qualifying activity that such variations in no way relax the requirements of this specification and that they are approved before testing is performed. For proposed test variations, a comparative error analysis shall be made available for checking by the qualifying activity (see 6.3).

4.4 Qualification inspection. Qualification inspection shall be performed at a laboratory acceptable to the Government (see 6.3) on sample units produced with equipment and procedures normally used in production. Qualification may be obtained without additional testing (see Appendix) by employing "characteristics qualification", provided switches are manifested by subordinate characteristics, all of which have been qualified themselves or have more rigorous, dominant characteristics in previously qualified switches.

4.4.1 Sample size. Four samples of the same PIN shall be subjected to qualification inspection tests specified herein.

4.4.2 Inspection routine. The sample shall be subjected to the qualification inspections specified in table II, in the order shown. All sample units shall be subjected to the inspections of group I. The sample shall then be divided into two groups of two units each (see 4.4.1). The sample units shall then be subjected only to the inspections indicated for their particular group.

TABLE II. Qualification inspection.

Examination or test	Requirement paragraph	Test paragraph
<u>Group I (all samples)</u>		
Screened per table III (screened switches only)	3.5.1	4.6.2
Visual and mechanical inspection (non-screened switches only)	3.1, 3.3, 3.4, 3.27, and 3.28	4.6.1
Run-in (non-screened switches only)	3.5.2	4.6.3
VSWR	3.5.3	4.6.4
Insertion loss	3.5.4	4.6.5
Isolation	3.5.5	4.6.6
Switching time	3.5.7	4.6.8
Operating current and voltage	3.5.8	4.6.9
Operating force (manually controlled)	3.5.9	4.6.10
<u>Group II (2 samples)</u>		
RF power handling capability <u>1/</u>	3.5.6	4.6.7
Insertion loss	3.5.4	4.6.5
Isolation	3.5.5	4.6.6
Dielectric withstanding voltage	3.6	4.6.11
Transient interference (RFI) (when specified)	3.8	4.6.13
RF energy leakage	3.9	4.6.14
Heat (fail-safe switches only)	3.10	4.6.15
Switching time	3.5.7	4.6.8
Solderability (switches with solderable leads or terminals)	3.11	4.6.16
Resistance to soldering heat (solderable leads)	3.12	4.6.17
Switching time	3.5.7	4.6.8
Operating current	3.5.8	4.6.9
Resistance to solvents	3.13	4.6.18
Terminal strength (switches with leads or terminals)	3.14	4.6.19
Thermal shock	3.15	4.6.20
Insertion loss	3.5.4	4.6.5
Isolation	3.5.5	4.6.6
Switching time	3.5.7	4.6.8
Altitude and cold	3.16	4.6.21
Switching time	3.5.7	4.6.8
Dielectric withstanding voltage	3.6	4.6.11

1/ When non-availability of test laboratory facility is demonstrated to the qualifying activity (see 6.3), the RF power handling capability requirement may be satisfied to the qualifying activity by technical records from system application(s) that quantify and benchmark the RF switch power handling performance and by use of system life performance guarantee. Qualifying activity approval is contingent upon review of quality history of manufacturers' switches in application systems.

TABLE II. Qualification inspection - Continued.

Examination or test	Requirement paragraph	Test paragraph
<u>Group II (2 samples)</u> continued		
Moisture resistance (types E and I only)	3.17	4.6.22
Insertion loss	3.5.4	4.6.5
Switching time	3.5.7	4.6.8
Dielectric withstanding voltage	3.6	4.6.11
Humidity (type E only)	3.18	4.6.23
VSWR	3.5.3	4.6.4
Isolation	3.5.5	4.6.6
Visual and mechanical inspection (nonscreened switches only)	3.1, 3.3, 3.4, 3.29, and 3.30	4.6.1
<u>Group III (2 samples)</u>		
Insulation resistance	3.7	4.6.12
Sand and dust (type E only)	3.19	4.6.24
Insertion loss	3.5.4	4.6.5
Switching time	3.5.7	4.6.8
Immersion (type I only)	3.20	4.6.25
Insertion loss	3.5.4	4.6.5
Switching time	3.5.7	4.6.8
Hermetic seal (type H only)	3.21	4.6.26
Life cycle	3.22	4.6.27
VSWR	3.5.3	4.6.4
Insertion loss	3.5.4	4.6.5
Isolation	3.5.5	4.6.6
Switching time	3.5.7	4.6.8
Explosion (types H and I only)	3.23	4.6.28
Insertion loss	3.5.4	4.6.5
Salt spray (types H and I only)	3.24	4.6.29
Switching time	3.5.7	4.6.8
Vibration	3.25	4.6.30
Insertion loss	3.5.4	4.6.5
Switching time	3.5.7	4.6.8
Acoustic noise (when specified)	3.26	4.6.31
VSWR	3.5.3	4.5.4
Insertion loss	3.5.4	4.6.5
Shock (specified pulse)	3.27	4.6.32
Insertion loss	3.5.4	4.6.5
Switching time	3.5.7	4.6.8
Solar radiation	3.28	4.6.33
Isolation	3.5.5	4.6.5
Switching time	3.5.7	4.6.8
Visual and mechanical inspection (non-screened switches only)	3.1, 3.3, 3.4, 3.27, and 3.28	4.6.1

4.4.3 Failures. One or more failures shall be cause for refusal to grant qualification approval. A failure shall be anything that does not meet the requirements of the specification.

4.4.4 Disposition of qualification sample units. Sample units which have been subjected to qualification testing shall not be delivered on any contract or purchase order. Sample units shall be clearly marked as such, to avoid accidental use. The government reserves the right to retain the sample units or to require the contractor to furnish the sample units with the qualification inspection report.

4.4.5 Retention of qualification. To retain qualification the contractor shall forward reports at 48-month intervals to the qualifying activity (see 6.3). The qualifying activity shall establish the initial reporting date. The report shall consist of the following:

- a. A summary of the results of the tests performed for inspection of product for delivery (group A), indicating as a minimum, the number of switches that have passed and the number that have failed. The results of the tests of all reworked switches shall be identified and accounted for.
- b. A summary of the results of tests performed for periodic (group B) inspection, including the number and mode of failures. The summary shall include results of all periodic inspection tests performed and completed during the 48-month period. If the summary of test results indicates nonconformance with specification requirements, and corrective action acceptable to the qualifying activity has not been taken, then action may be taken to remove the failing product from the qualified products list (QPL).

Failure to submit the report within 60 days after the end of each 48-month period may result in the loss of qualification for the product. In addition to the periodic submission of inspection data, the contractor shall immediately notify the qualifying activity at any time during the 48-month period that the inspection data indicates failure of the qualified product to meet the requirements of this specification.

In the event that no production occurred during the reporting period, a report shall be submitted certifying that the company still has the capabilities and facilities necessary to produce the switches. If during the two consecutive reporting periods there has been no production, then the manufacturers may be required, at the discretion of the qualifying activity, to submit their qualified products to testing in accordance with the qualification inspection requirements and to provide the reason why there was no production.

4.5 Conformance inspection.

4.5.1 General. Conformance inspection shall consist of group A inspection, screening (when applicable), and group B inspection. Group B inspection shall be performed under periodic inspection.

4.5.1.1 Inspection lot. An inspection lot shall consist of all switches, with the same PIN, produced under essentially the same conditions, and offered for inspection at one time.

4.5.1.2 Screening. Screening shall consist of the inspection and tests specified in table III in the order shown. Switches shall pass screening before being subjected to group A inspection.

TABLE III. Screening.

Examination or test	Requirement paragraph	Test method paragraph
Stabilization bake (hermetically sealed switches only)	3.5.1	4.6.2.1
Thermal shock	3.5.1	4.6.2.2
Burn-in (logically controlled switches only)	3.5.1	4.6.2.3
Run-in	3.5.2	4.6.2.4
Visual and mechanical inspection	3.5.1	4.6.2.5

4.5.1.3 Group A inspection. Group A inspection shall consist of the examinations and tests specified in table IV, in the order shown. Tests and examinations shall be performed at room ambient temperature.

TABLE IV. Group A inspection.

Examination or test	Requirement paragraph	Test method paragraph
Visual and mechanical (non-screened switches only)	3.1, 3.3, 3.4, 3.29 and 3.30	4.6.1
Run-in (non-screened switches only)	3.5.2	4.6.3
VSWR	3.5.3	4.6.4
Insertion loss	3.5.4	4.6.5
Isolation	3.5.5	4.6.6
Switching time	3.5.7	4.6.8
Operating current and voltage	3.5.8	4.6.9
Operating force (manually controlled)	3.5.9	4.6.10

4.5.1.4 One hundred-percent inspection. All screened switches shall be subjected to screening and to group A inspection. All non-screened switches shall be subjected to group A inspection. Defective units shall be individually rejected.

4.5.1.5 Rejected items. If an inspection item is rejected, the supplier may rework it to correct the defect, and resubmit for reinspection. Such items shall be separate from new items, and shall be clearly identified as reinspected items.

4.5.2 Periodic inspection. Periodic inspection shall consist of group B inspection. Except where the results of these inspections show noncompliance with the applicable requirements (see 4.5.2.5), delivery of products which have passed the screening and the group A inspections (screened items only) or group A inspection (non-screened items only) shall not be delayed pending the results of these periodic inspections.

4.5.2.1 Group B inspection. Group B inspection shall consist of the inspections, specified in table V, in the order shown. The sample shall be divided into two groups of two units each. The units shall then be subjected only to the inspection indicated for their particular group. Group B inspection shall be made on sample units selected from inspection lots which have passed the group A inspection.

4.5.2.2 Sample plan. Four sample units (see 4.4.2) shall be selected every 48 months. The first inspection shall be 48 months after the date of notification of qualification approval.

4.5.2.3 Failures. If one or more sample units fail to pass group B inspection, the sample shall be considered to have failed.

4.5.2.4 Disposition of sample units. Sample units which have been subjected to group B inspection shall not be delivered on contract.

4.5.2.5 **Noncompliance.** If a sample fails to pass group B inspection, the manufacturer shall notify the qualifying activity and cognizant inspection activity of such failure and take corrective action on the material or processes, or both, as warranted, and on all units of product which can be corrected and which are manufactured under essentially the same conditions, with essentially the same materials and processes, and which are considered subject to the same failure. Acceptance and shipment of the product shall be discontinued until corrective action, acceptable to the Government, has been taken. After the corrective action has been taken, group B inspection shall be repeated on additional sample units (all inspections, or the inspection which the original sample failed) at the option of the qualifying activity. Group A inspection may be re-instituted; however, final acceptance shall be withheld until the group B inspection has shown that corrective action was successful. In the event of failure after inspection, information concerning the failure and the corrective action taken shall be furnished to the cognizant inspection activity and to the qualifying activity.

TABLE V. Group B inspection.

Examination or test	Requirement paragraph	Test method paragraph
<u>Group I (2 samples)</u>		
RF power handling capability <u>1/</u>	3.5.6	4.6.7
Dielectric withstanding voltage	3.6	4.6.11
Transient interference (RFI) (when specified)	3.8	4.6.13
RF energy leakage	3.9	4.6.14
Heat (fail-safe switches only)	3.10	4.6.15
Switching time	3.5.7	4.6.8
Solderability (switches with solderable leads or terminals)	3.11	4.6.16
Resistance to soldering heat (switches with solderable leads or terminals)	3.12	4.6.17
Switching time	3.5.7	4.6.8
Operating current	3.5.8	4.6.9
Resistance to solvents	3.13	4.6.18
Terminal strength (switches with leads or terminals)	3.14	4.6.19
Thermal shock	3.15	4.6.20
Insertion loss	3.5.4	4.6.5
Isolation	3.5.5	4.6.6
Switching time	3.5.7	4.6.8
Altitude and cold	3.16	4.6.21
Switching time	3.5.7	4.6.8
Dielectric withstanding voltage	3.6	4.6.11
Moisture resistance (types E and I only)	3.17	4.6.22
Insertion loss	3.5.4	4.6.5
Switching time	3.5.7	4.6.8
Dielectric withstanding voltage	3.6	4.6.11
Humidity (type E only)	3.18	4.6.23
VSWR	3.5.3	4.6.4
Isolation	3.5.5	4.6.6
Visual and mechanical inspection	3.1, 3.3, 3.4, 3.29, and 3.30	4.7.1

1/ When non-availability of test laboratory facility is demonstrated to the qualifying activity (see 6.3), the RF power handling capability requirement may be satisfied to the qualifying activity by technical records from system application(s) that quantify and benchmark the RF switch power handling performance and by use of system life performance guarantee. Qualifying activity approval is contingent upon review of quality history of manufacturers' switches in application systems.

TABLE V. Group B inspection - Continued.

Examination or test	Requirement paragraph	Test paragraph
<u>Group II (2 samples)</u>		
Insulation resistance	3.7	4.6.12
Sand and dust (type E only)	3.19	4.6.24
Insertion loss	3.5.4	4.6.5
Switching time	3.5.7	4.6.8
Immersion (type I only)	3.20	4.6.25
Insertion loss	3.5.4	4.6.5
Switching time	3.5.7	4.6.8
Hermetic seal (type H only)	3.21	4.6.26
Life cycle	3.22	4.6.27
VSWR	3.5.3	4.6.4
Insertion loss	3.5.4	4.6.5
Isolation	3.5.5	4.6.6
Switching time	3.5.7	4.6.8
Explosion	3.23	4.6.28
Insertion loss	3.5.4	4.6.5
Salt spray (types H and I only)	3.24	4.6.29
Switching time	3.5.7	4.6.8
Vibration	3.25	4.6.30
Insertion loss	3.5.4	4.6.5
Switching time	3.5.7	4.6.8
Acoustic noise (when specified)	3.26	4.6.31
VSWR	3.5.3	4.6.4
Insertion loss	3.5.4	4.6.5
Shock (specified pulse)	3.27	4.6.32
Insertion loss	3.5.4	4.6.5
Switching time	3.5.7	4.6.8
Solar radiation	3.28	4.6.33
Isolation	3.5.5	4.6.6
Switching time	3.5.7	4.6.8
Visual and mechanical inspection	3.1, 3.3, 3.4, 3.29, and 3.30	4.6.1

4.6 Methods of inspection.

4.6.1 Visual and mechanical inspection. Switches shall be examined to verify that the materials, interface, physical dimensions, finish, marking, serialization, and workmanship are in accordance with applicable requirements.

4.6.2 Screening. Switches shall be screened as specified in 4.6.2.1 through 4.6.2.5 (see 3.5.1).

4.6.2.1 Stabilization bake. Hermetically sealed switches shall be subjected to a stabilization bake temperature of 100 deg C for a period of 24 hours during which time the switches shall be non-operated. Following this test, the switch shall pass the hermetic seal requirement (see 3.21).

4.6.2.2 Thermal shock. With the connections covered (at the manufacturer's discretion), switches shall be tested in accordance with method 107 of MIL-STD-202, test condition B, using normal mounting. Except the temperature extremes shall be -55 deg C to +105 deg C, and the number of cycles shall be 10. Place switches in the cold chamber for one-half hour. Switches should be positioned to be exposed to freely circulating chamber air. Remove switches from the cold chamber and place them in the hot chamber for one-half hour. Transfer shall take place within five minutes of removal from the cold chamber. One cycle consists of room temperature to cold, to room temperature to hot, and back to room temperature.

4.6.2.3 Burn-in. (For logically controlled switches, that do not use previously burned-in sub-components). Devices may be securely mounted on a block weighing not less than five times the weight of the switch and shall be placed within a temperature chamber, and the dc power supply voltage shall be connected. The maximum dc power supply voltage shall be applied to the switches, and the chamber temperature shall be raised so that the measured housing temperature is equal to the specified highest operating temperature. The switches shall remain under these conditions for a period of 160 hours. Electrical measurements before or during burn-in shall be at the discretion of the manufacturer.

4.6.2.4 Run-in. Switches shall be tested as specified in 4.6.3.

4.6.2.5 Visual and mechanical inspection. Visual and mechanical inspection of switches shall be as specified in 4.6.1.

4.6.3 Run-in. Using the test setup in figure 1A or 1B (or equivalent), the switch shall be operated at a rate not to exceed ten positions per second (or for fast switching devices, at a rate approved by qualifying activity, dependent upon the device switching time) for 4,800 cycles. One cycle shall consist of switching from the initial position into each other position and returning to the initial position. Switches with externally accessible contacts (such as indicating or interlock circuit contacts) shall have the contact resistance of these contacts measured and recorded both before and after run-in. Any contact resistance measurement greater than 250 milliohms, at 5 milliamperes current, shall be cause for rejecting these switches (see 3.5.2).

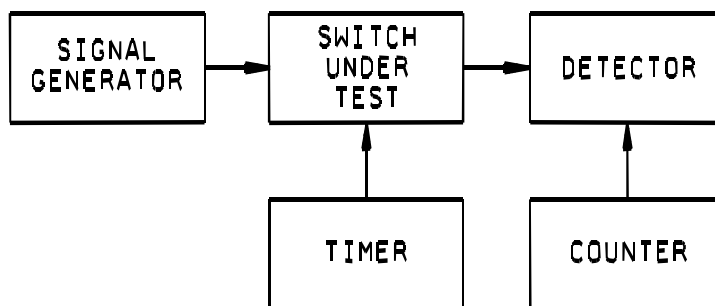


FIGURE 1A. Run-in and cycle life test setup (or equivalent).

4.6.4 Voltage standing wave ratio. With the switch at ambient room temperature, measure the VSWR for each RF path across the specified frequency range (see 3.1), using the test setup of figure 2A or 2B (or equivalent). RF input power between -30 dBm and +20 dBm shall be used for this test. Each unused port shall be terminated in a matched load. Permanent record of the switch's VSWR versus frequency data shall be recorded with a minimum resolution of 0.05 between VSWR limits of 1.02:1 and 1.5:1 and of 0.10 above 1.5:1. If VSWR is not directly measured; that is, if return loss is measured and VSWR calculated from that measurement, then the permanent record shall indicate the worst case VSWR numerically and shall provide the calculation used to obtain the calculated VSWR. The measurement system and permanent record shall employ state-of-the-art test equipment capable of minimum measurement accuracy of .04 for frequencies below 26.5 GHz and of .08 for frequencies 26.5 GHz and above (see 3.5.3).

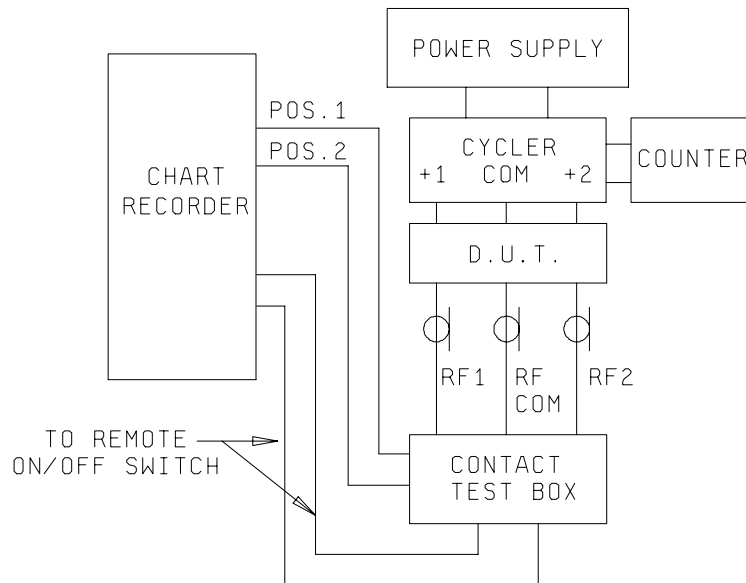


FIGURE 1B. Run-in and cycle life test set-up
(Alternate dc test method) (or equivalent).

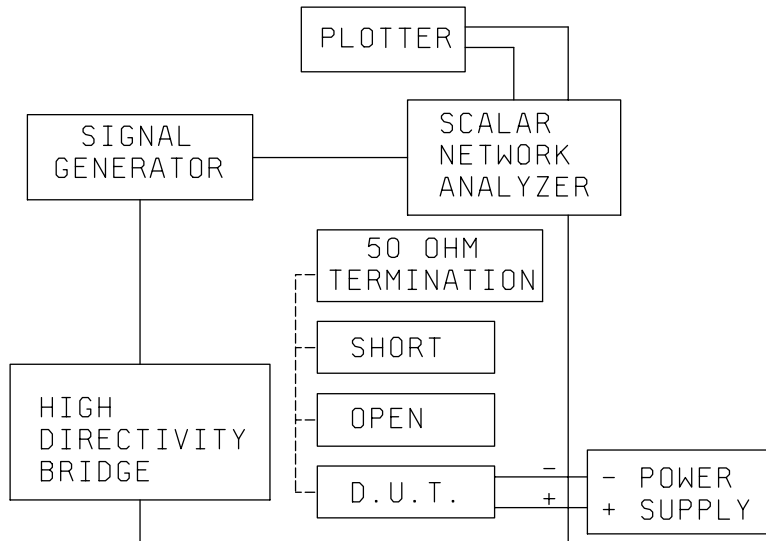
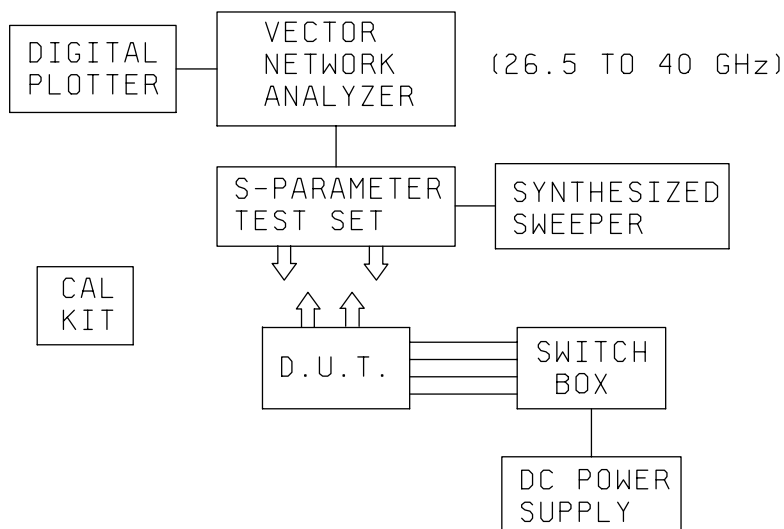


FIGURE 2A. Voltage standing wave ratio measurement (VSWR) test setup
(Scalar Network Analyzer Method) (or equivalent).

FIGURE 2B. VSWR test set-up (vector analyzer method).

4.6.5 Insertion loss (see 3.5.4). With the switch at ambient room temperature, apply nominal operating voltage (see 3.1) and measure the insertion loss for each RF path, using the general test procedures and test setup of 4.6.6 or using the insertion loss test setup of figure 3B (or equivalent). Calibration lines shall be plotted .02 dB above and below the specified insertion loss value. The state-of-the-art measurement recording system shall provide a minimum measurement accuracy of .04 dB for frequencies below 26.5 GHz and of .08 dB for frequencies 26.5 GHz and above.

4.6.6 Isolation (see 3.5.5). Utilize the isolation test setup in figure 3A (or equivalent). Low pass filter shall attenuate all harmonics of the RF signal for at least 30 dB. Measurements shall be recorded over the specified (see 3.1) frequency range. Plot calibration lines in 1 dB steps above and below the specified isolation value of the switch. Terminate all unused ports with matched loads. With the switch at ambient room temperature, apply the nominal operating voltage and record the isolation versus frequency. The frequency shall be labeled and recorded across the frequency band. Repeat the above procedures for any other adjacent ports. The overall inaccuracy of isolation measurements shall be no greater than 5 percent.

4.6.7 RF power handling capability (see 3.5.6). The RF power sources shall be capable of furnishing the specified average and peak power to the input of the switch. The output of the switch shall be terminated in a 50 Ω load. The temperature of the switch shall reach equilibrium (not vary more than ± 3 deg C within a 15 minute period) prior to initiation of the test. The power source shall be adjusted to the highest specified frequency and the specified peak power. Apply this power to the input of the switch for at least five minutes. At the end of this time, remove the peak power and apply the specified average power (at the same frequency) to the input of the switch for at least one hour. Repeat these same procedures at the specified middle frequency and at the lowest frequency. The above procedures shall be repeated for each position of the switch. If required to switch under power and if the switch design includes interlock circuits used to interrupt the RF power source during switching (see 3.1), the circuits shall be used to do so during this test. When non-availability of test laboratory facility is demonstrated to the qualifying activity (see 6.3), the RF power handling capability requirement may be satisfied to the qualifying activity by technical records from system application(s) that quantify and benchmark the RF switch power handling performance and by use of system life performance guarantee. Qualifying activity approval is contingent upon review of quality history of manufacturers' switches in application systems.

MIL-DTL-3928F

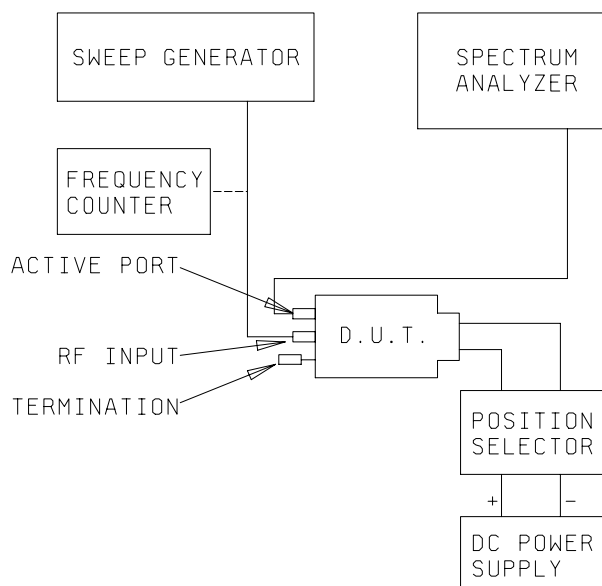


FIGURE 3A. Isolation test set-up (or equivalent).

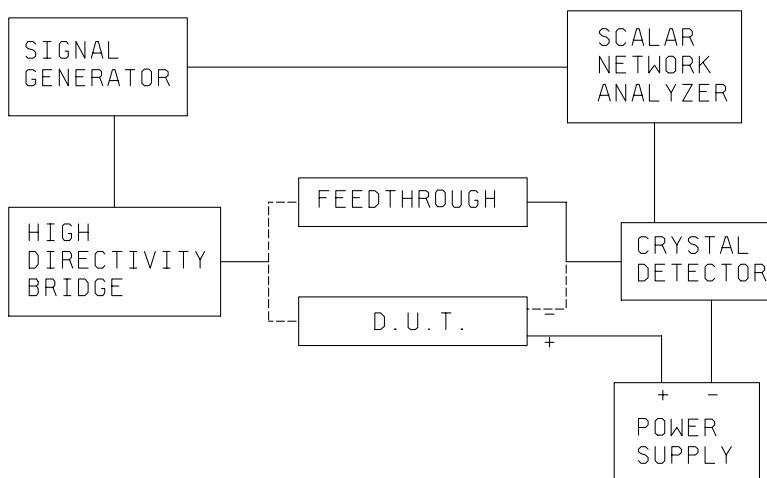


FIGURE 3B. Insertion loss test set-up (or equivalent).

4.6.8 Switching time (see 3.5.7). For electrically operated switches, the switching time from both the energized and the de-energized positions shall be measured, using the test setup of figure 4 (or equivalent). With the switch at ambient room temperature, apply RF and dc power and measure the time lapse between application of dc actuator power and final positioning of the RF portion of the switch for the position selected. Measure the time lapse for the switch to go from an energized position to a deenergized position. Repeat these tests for each electrically selected position of the switch.

MIL-DTL-3928F

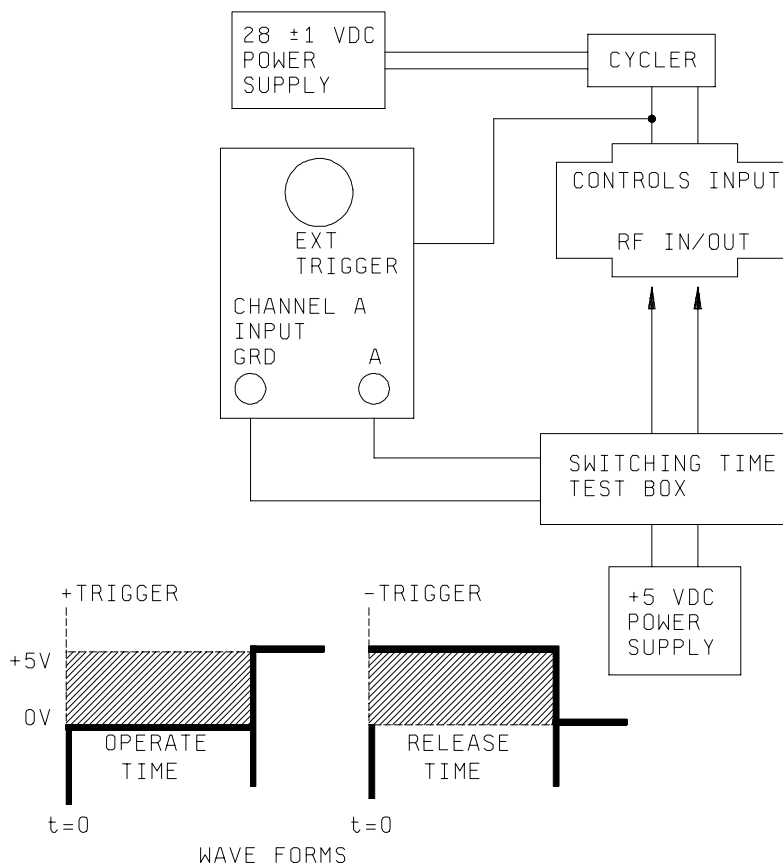


FIGURE 4. Switching time test setup (or equivalent).

4.6.9 Operating current and voltage (see 3.5.8). The operating current and voltage of the switches shall be measured as specified in 4.6.9.1 through 4.6.9.4.

4.6.9.1 Pull-in voltage. With the switch at ambient room temperature, connect a voltmeter directly across the input terminals of the selected position. Increase the actuator voltage and note the actual voltage at which the actual switching action occurs. Repeat this test for each position requiring the application of actuator power. Repeat the above procedure with the switch at the lowest and highest specified operating temperature (see 3.1).

4.6.9.2 Dropout voltage (fail-safe type). With the switch at ambient room temperature, connect a voltmeter across the terminals of the selected switch position and apply nominal operating voltage (see 3.1). Gradually reduce the actuator voltage until the switch returns to the deenergized position. The above test shall be repeated for each switch position requiring actuator power.

4.6.9.3 Operating current. With the switch at ambient room temperature, apply nominal operating voltage (see 3.1) and measure the operating current for each RF position, using the test setup of figure 5. Repeat the above procedure with the switch at the lowest and highest specified operating temperature (see 3.1). Care should be taken during the measurements to insure that the temperature of the switch has stabilized.

4.6.9.4 Holding current (fail-safe and selective type switches). The holding current for each RF position shall be measured using the same procedures and equipment as 4.6.9.3. The holding current shall be measured at ambient room temperature, at minimum operating temperature and at maximum operating temperature.

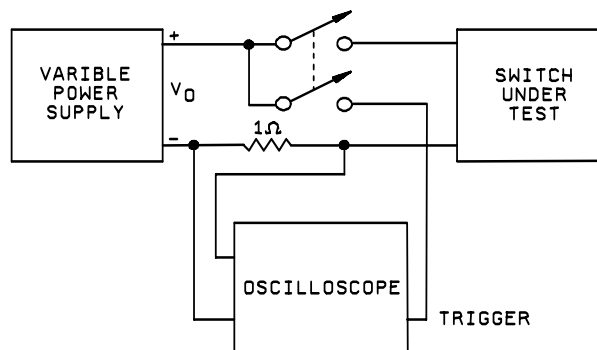


FIGURE 5. Operating and holding current test setup.

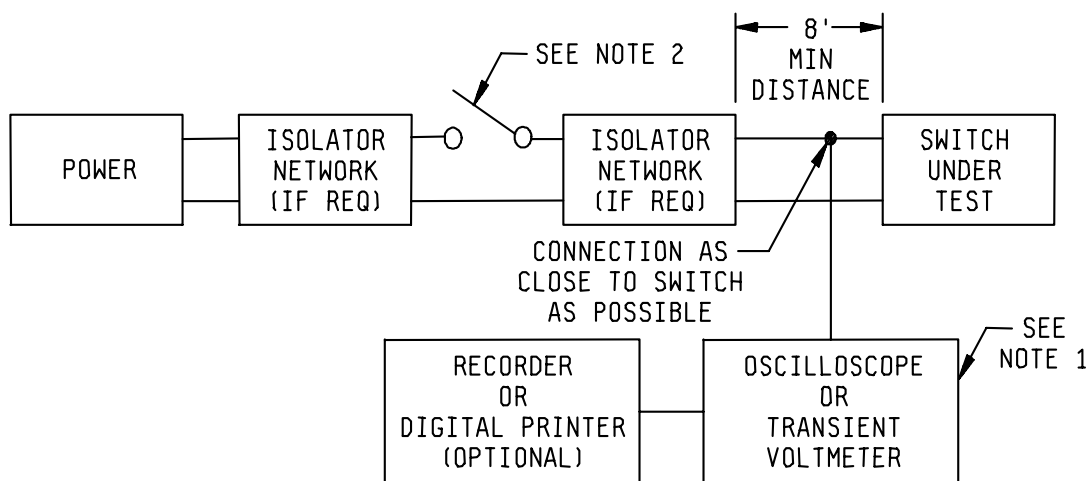
4.6.10 Operating force (manually controlled switches, see 3.5.9). No more than a push or pull force of 5 pounds or a torque of 12 pound-inches or 2.5 pound-inches minimum shall be applied to initiate a change in position.

4.6.11 Dielectric withstanding voltage (see 3.6). Switches shall be tested in accordance with method 301 of MIL-STD-202. The following details shall apply:

- a. Magnitude of test voltage:
 - (1) RF connectors: As specified on applicable connector specification.
 - (2) Actuator and indicator terminals:
 - (a) DC operated switches: 1,000 V dc.
 - (b) AC operated switches: 1,000 V dc.
- b. Points of application of test voltage:
 - (1) Indicator and interlock circuit: The test voltage shall be applied in turn between each separate position indicator and interlock circuit terminal and the switch house (ground). All open indicator and interlock circuit terminals shall be connected (shorted) together for test to prevent damage to the indicator and interlock circuit.
 - (2) Actuator circuit: The test voltage shall be applied between the actuator terminals and the switch housing (ground). All actuator terminals shall be connected together for this test so that any RFI noise suppression devices are not damaged.
- c. Repeated application of test voltage: Precautions paragraph 1.1 of MIL-STD-202, method 301 applies, in that repeated application of test voltage on the same specimen is not recommended. When approved by the qualifying activity (see 6.3) subsequent application of test potential conducted on the same specimen may use reduced test voltage (provided test voltage equals or exceeds 50% of original test requirement).

4.6.12 Insulation resistance (RF connectors, see 3.7). Switches shall be tested in accordance with method 302 of MIL-STD-202, test condition C. The points of measurement for RF connector test are: To ground and to each other open pin.

4.6.13 Transient interference (RFI) (when specified) (see 3.8). Transient interference emanating from the switch shall be measured on the power lines using the test procedure of figure 6.



NOTES:

1. Oscilloscope or transient voltmeter should be of the memory storage type and be capable of detecting and measuring:

Magnitude:	± 1 volt to $\pm 1,000$ volts.
Width:	50 nanoseconds to 100 milliseconds.
Pulse repetition frequency:	Single shot to 500 PPS.
Input impedance:	100 K Ω minimum.

2. Use of a low noise mercury switch is recommended to activate the coaxial switch.

Procedure:

- a. Activate switch at least 20 times.
- b. Highest reading obtained is to be recorded for both make and break.

FIGURE 6. RFI transient test arrangement and test procedure.

4.6.14 RF energy leakage (see 3.9). Using a state-of-the-art test setup for RF leakage detector calibration, the input of the switch shall be furnished with a minimum of 10 milliwatts of RF power at the center frequency of the switch pass band. Calibration sensitivity of the test position shall be 90 dB relative to the power output of the RF source. Each output port shall be terminated in a matched load. The entire external surface of the switch shall be explored for maximum RF leakage. This test shall be repeated for each switch position.

4.6.15 Heat (fail-safe switches only) (see 3.10). The switch shall be energized with the maximum operating voltage and current and held in this position. The energized switch shall then be placed in an oven at the maximum rated operating temperature of the switch (see 3.1) and kept at this temperature for 4 hours. At the end of the 4 hours, the switch shall be tested, at nominal operating voltage, for switching time (see 4.6.8).

4.6.16 Solderability (switches with solderable leads or terminals) (see 3.11). The terminals of the switch shall be tested in accordance with method 208 of MIL-STD-202. A "dummy unit" or switch cover fabricated with terminals or solderable connectors from the same material lot as those used for switch manufacture may be used, in lieu of an active device, to satisfy this test requirement.

4.6.17 Resistance to soldering heat (switches with solderable leads or terminals) (see 3.12). Switches shall be tested in accordance with method 210 of MIL-STD-202. The following details and exceptions shall apply:

- a. Special preparation: The terminals shall not have been soldered previously.
- b. Depth of immersion in the molten solder: To a point .0625 + .0312, -0 inch from the body.
- c. Test condition: A.
- d. Cooling time: Stabilize to +25 deg C.

4.6.18 Resistance to solvents (see 3.13). Switches shall be tested in accordance with method 215 of MIL-STD-202. All portions of the switch shall be brushed. The RF connectors shall be capped.

4.6.19 Terminal strength (switches with leads or terminals) (see 3.14). Switches shall be tested in accordance with 4.6.19.1, 4.6.19.2, or 4.6.19.3.

4.6.19.1 Solder terminals. These switches shall be tested in accordance with method 211 of MIL-STD-202, test condition A. The applied force shall be 4.5 pounds.

4.6.19.2 Lead integrity. Switches with leads shall be tested in accordance with method 211 of MIL-STD-202, test condition C. The applied force shall be 8 ± 0.5 ounces. For leads with a section modulus equal to or less than that of a lead with a cross section of .006 x .20, the force shall be 3 ± 0.3 ounces.

4.6.19.3 Screw terminals. These switches shall be subjected to the tests specified in 4.6.19.3.1 and 4.6.19.3.2.

4.6.19.3.1 Pull. The terminals shall be subjected to a pull of the applicable static force specified in table VI, in a direction along the axis of the terminal screw, in a direction perpendicular to the axis of the terminal screw, and in the direction most likely to cause failure. The force shall be applied for one minute in each of the directions.

TABLE VI. Static values of force.

Thread size	Force in pounds
.112 - 40 UNC - 2A (4-40)	5
.138 - 32 UNC - 2A (6-32)	30
.164 - 32 UNC - 2A (8-32)	35
.190 - 32 UNC - 2A (10-32)	40
.190 - 24 UNC - 2A (10-24)	40
.250 - 28 UNC - 2A (1/4-28)	50

4.6.19.3.2 Torque. Terminals of the switches shall be tested in accordance with method 211 of MIL-STD-202, test condition E. Except that for thread size .190 - 24 UNC, the torque shall be 24.0 pound-inches. The direction of torque shall be in the direction which will tighten the screws.

4.6.20 Thermal shock (see 3.15). Switches shall be tested as specified in 4.6.2.2.

4.6.21 Altitude and cold (see 3.16). Switches shall be placed in a pressure chamber maintained at a temperature of -55 deg C +0 deg C, -5 deg C for 24 hours. After temperature stabilization, the switching time shall be measured as specified in 4.6.8. The pressure shall then be changed as quickly as the chamber permits from standard ambient barometric pressure to 1.3 inches of mercury (approximately 70,000 feet elevation) and then stabilized. During the last 4 hours of the 24 hour holding period, the switches shall be tested to determine the dielectric withstanding voltage and switching time (see 4.6.11 and 4.6.8, respectively). For the dielectric withstanding test, only one-half of the voltage specified in 4.6.11 shall be applied. This voltage shall not be applied during the actual switching operation. Remotely controlled switches shall be operated with the minimum actuator voltage (see 3.5.8).

4.6.22 Moisture resistance (types E and I only) (see 3.17). Switches shall be tested in accordance with method 106 of MIL-STD-202. Protective connector caps shall be used during test. The following details shall apply:

- a. Initial measurements: Not applicable.
- b. Polarization voltage: Not applicable.
- c. Loading voltage: Not applicable.
- d. Final measurements: Unless otherwise specified (see 3.1), the following measurements shall be made within five minutes after removal from humidity:
 - (1) Insertion loss (see 4.6.5).
 - (2) Switching time (see 4.6.8).
 - (3) Dielectric withstanding voltage (see 4.6.11).

4.6.23 Humidity (type E only)(see 3.18). Switches shall be tested in accordance with method 103 of MIL-STD-202. The following details shall apply:

- a. Measurements after conditioning: Not applicable.
- b. Test condition letter: B (protective connector caps shall be used during test).
- c. Final measurements: After drying period, voltage standing wave ratio and isolation shall be measured as specified in 4.6.4 and 4.6.6, respectively.

4.6.24 Sand and dust (type E only) (see 3.19). Closed switches shall be tested in accordance with method 110 of MIL-STD-202, except the duration shall be one-half hour only. The following details shall apply:

- a. Test condition letter: A (protective connector caps shall be used during test).
- b. High velocity: Applicable.

4.6.25 Immersion (type I only) (see 3.20). Immersion proof switches shall be tested in accordance with method 104 of MIL-STD-202. With qualifying activity approval, MIL-STD-202, method 112 may be used. The following details shall apply:

- a. Test condition letter: A (protective connector caps shall be used during test), for method 104.
D, for method 112.
- b. During test cycle and while submerged, the sample shall be subjected to a low barometric pressure of 3.44 in Hg (50,000 feet altitude).
- c. Measurements: No leakage as evidenced by a continuous stream of bubbles. Bubbles which are the results of entrapped air on the exterior surface of the switch shall not be considered an indication of leakage. Following this test, the insertion loss and switching time shall be measured as specified in 4.6.5 and 4.6.8, respectively.

4.6.26 Hermetic seal (type H only) (see 3.21). Hermetically sealed switches shall be tested in accordance with method 112 of MIL-STD-202, test condition C (protective connector caps shall be used during test). Procedure III shall be used. For the degree of leakage rate sensitivity, see 3.21.

4.6.27 Life cycle (see 3.22). The switch shall be securely mounted on a block weighing not less than five times the weight of the switch; the switch temperature shall be allowed to stabilize at ambient room temperature for a minimum of one hour before the beginning of the test. Unless specified, RF power need not be applied to the switch. Using the test setup of figure 1, the switch shall be operated at a rate approved by the qualifying activity based upon device switching time, for the number of cycles specified. The interval between change of positions shall be no less than twice the switching speed specification (see 3.1). One cycle shall consist of switching from the initial position into each other position and returning to the initial position. The operating voltage shall be nominal (+10, -0 percent). When indicator or interlock circuits are included in the design, they shall be energized with the specified current and voltage (see 3.1) during the test. The contact resistance of these circuits shall be measured at the switch connector or terminals before and after this test. Any contact resistance measurement greater than 240 milliohms shall be cause for rejecting the switch.

4.6.28 Explosion (types H and I only) (see 3.23). Switches shall be tested in accordance with method 109 of MIL-STD-202. Following the test, insertion loss shall be measured as specified in 4.6.5.

4.6.29 Salt spray (types H and I only) (see 3.24). Switches shall be tested in accordance with method 101 of MIL-STD-202. These details shall apply:

- a. Salt solution: Five percent solution.
- b. Special mounting: Nonferrous materials shall be used to hold the part under test.
- c. Test condition letter: B.
- d. Following this test, visual inspection shall be made, and the insertion loss and switching time shall be measured as specified in 4.6.5 and 4.6.8, respectively. During the test, the RF connectors should be protected by suitable caps.

4.6.30 Vibration (see 3.25). Switches shall be tested in accordance with method I or method II as specified (see 3.1).

- a. Method I. MIL-STD-202, method 204, the following details shall apply:
 - (1) Mounting: Rigidly mounted.
 - (2) Electrical load: A suitable indicating device shall be connected across the closed contacts to determine if contacts remain in the proper position.
 - (3) Test condition letter: C, except the frequency cycle shall be swept three times in each of three mutually perpendicular directions, one of which shall be parallel to the line of action of the RF switching mechanism (total of approximately three hours).
 - (4) Resonance: Not applicable.
 - (5) Measurements: During the test, a suitable indicating device shall be connected across the closed contacts to determine if contacts remain continuously in the proper position (10 microseconds of chatter allowed for response time of chatter monitoring equipment). During the test, the switch shall be actuated and cycled through each position five times. At each position, any sign of intermittent contact shall be noted. Following the test, the insertion loss and switching time shall be measured as specified in 4.6.5 and 4.6.8, respectively.

b. Method II. MIL-STD-202, method 201, the following details shall apply:

- (1) Test and measurements prior to vibration: None.
- (2) Method of mounting: Rigidly mounted.
- (3) Test and measurements during and after vibration: During the test a suitable indicating device shall be connected across the closed contacts to determine if contacts remain continuously in the proper position (10 microseconds of chatter allowed for response time of chatter monitoring equipment). Following the test, the insertion loss and switching time shall be measured as specified in 4.6.5 and 4.6.8, respectively.

4.6.31 Acoustic noise (when specified, see 3.26). Switches shall be tested in accordance with method 515 of MIL-STD-810. The following details shall apply:

- a. Pretest data: Not required.
- b. Test category: As specified (see 3.1).
- c. Operation during test: Not required.
- d. Following test, voltage standing wave ratio (VSWR) and insertion loss shall be as specified in 4.6.4 and 4.6.5, respectively.

4.6.32 Shock (specified pulse) (see 3.27). Switches shall be tested in accordance with method 213 of MIL-STD-202, test condition G, as applicable. The following details shall apply:

- a. Special mounting: Not applicable.
- b. Reference surface: Not applicable.
- c. Measurements: Following this test, the insertion loss and switching time shall be measured as specified in 4.6.5 and 4.6.8 respectively.

4.6.33 Solar radiation (sunshine) (see 3.28). Switches shall be tested in accordance with MIL-STD-810, method 505, procedure I, except exposure to solar radiation energy shall be at a rate of 360 BTU per square foot per hour.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of material is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The switches covered by this specification are military unique due to the fact that these devices must be able to operate satisfactorily in military systems. Switches covered by this specification are intended for use with RF coaxial transmission line systems. Uses include antenna switching, receiver or component protection, load divider circuits, and the control of display signals. Commercial components are not designed to withstand these military environmental conditions.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of applicable specification sheet, class, and complete PIN.
- b. Indicating circuits (see 3.4.11).
- c. Sequence, if other than break-before-make (see 3.4.4).
- d. If resistance termination is to be other than 50 ohms (see 3.4.5).
- e. If continuous duty is required (see 3.4.7).
- f. Whether switches are required to switch under power (see 3.5.6).
- g. Specify if measurements of moisture resistance are other than specified (see 4.6.22 d).
- h. When aluminum should not be anodized (see 3.3.5).
- i. When the desired switch housing is to be vented (for space applications) (see 3.4.12). With Qualifying Activity approval (see 6.3), space application unique requirements, eg. environmental test requirements or limitations and design details not specifically addressed in this specification, may be tailored by the acquisition document.
- j. Packaging requirements (see 5.1).

6.3 Qualification. Awards will be made only for products which are, at the time set for opening of bids, qualified for inclusion in the applicable qualified products list, whether or not such products have actually been listed by that date. Contractor attention is called to this requirement, and manufacturers are urged to arrange to have products they propose to offer to the Government tested for qualification, in order that they may be eligible to be awarded contracts for products covered by this specification. The activity responsible for the qualified products list, and from whom information pertaining to product qualification may be obtained, is Defense Supply Center Columbus, Code DSCC-VQE, P.O. Box 3990, Columbus, OH 43216-5000, vqe.chief@dla.mil.

6.4 Definitions. For the purpose of this specification, the following definitions apply.

6.4.1 Dropout voltage. The dropout voltage is defined as the voltage at which a switch returns to its proper de-energized state.

6.4.2 Fail-safe switch. A fail-safe switch is defined as a switch with an actuator that contains a spring return mechanism that provides an RF connection to one selected position when no dc or ac voltage is applied to the switch. This type of switch requires a continuous voltage to maintain an RF connection to any other position.

6.4.3 Holding current. The holding current is defined as the current required to hold the switch in position after the RF contacts have completely transferred.

6.4.4 Indicating circuit. An indicating circuit is a circuit that remotely indicates the switch position. This is normally done with indicator lights. The indicating circuit is a set of contacts or a switching circuit that is controlled by the same shaft or control circuit that operates the RF switch.

6.4.5 Latching switch. A latching switch is defined as a switch that contains a mechanism, either mechanical or magnetic, that will maintain a chosen RF position and that requires no voltage to maintain the position after the switching action is completed.

6.4.6 Pull-in voltage. The pull-in voltage is defined as the minimum operating voltage at which the switch contacts assume the energized position.

6.4.7 Rotor motion delay. The rotor motion delay is defined as the time between application of the switching voltage and the beginning of rotor motion.

6.4.8 Switching time. The switching time is defined as beginning when the dc operating voltage, or logic voltage, is first applied and ending when the switch RF signal reaches its steady-state value. Switching time consists of the following time elements:

- a. Inductive delay time in the actuator coil.
- b. Transfer time of the RF contacts.
- c. Bounce time of the RF contacts.

6.4.9 Transfer switch. A transfer switch is defined as a switch with four ports and provides two independent pairs of RF paths. These pairs are actuated simultaneously.

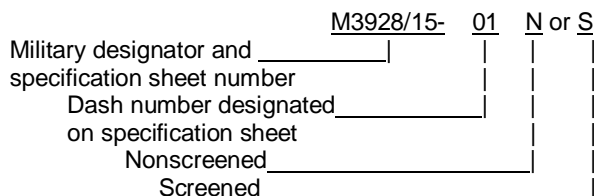
6.4.10 Operating current. The operating current is that current required for satisfactory operation of the switch. The value of the current is normally specified for operation at ambient room temperature.

6.4.11 Interlock circuits. An interlock circuit is designed into a latching type of switch. The switch will remain in the last position, until the switch is re-energized.

6.4.12 Normally open switch. A normally open switch is defined as a switch with an actuator that contains a spring return mechanism that provides no RF connection when no dc or ac voltage is applied to the switch. This type of switch requires a continuous voltage to maintain an RF connection to any other RF position.

6.4.13 Duty cycle. The amount of time a switch operates, as opposed to its idle time. Intermittent duty refers to switch operation for specified alternate intervals of load and no load. Continuous duty refers to switch operation for an indefinite length of time.

6.5 Part or identifying number (PIN). The military PIN consists of the letter "M" followed by the basic number of the specification sheet, an assigned dash number (see 3.1), and the letter N or S; where N indicates a nonscreened item and S indicates a screened item. PINs without N or S are considered nonscreened items.



6.6 Subject term (key word) listing.

configuration	insertion loss	solenoid
connectors	insulation resistance	VSWR
contact bounce	interference	
dielectric withstanding voltage	isolation	
dropout	latching	
duty	life cycle	
fail-safe	motor	
fungus inert	operating force	
hermetic	pull-in	
holding current	qualification	
housing	screening	
indicating circuit	sequence	

6.7 Finish.

6.7.1 Painted finish. Based on past experience, painted finish in accordance with MIL-F-14072, type II, has been used successfully to meet the requirements of this specification.

6.7.2 Chemical conversion coating. Based on past experience, treatment of aluminum in accordance with MIL-C-5541, class 3, has been used successfully to meet the requirements of this specification.

6.7.3 Anodized finish. Based on past experience, anodized finish in accordance with MIL-A-8625, type II, class 2, has been used successfully to meet the requirements of this specification.

6.8 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

6.9 Environmentally preferable material. Environmentally preferable materials should be used to the maximum extent possible to meet the requirements of this specification. Table VII lists the Environmental Protection Agency (EPA) top seventeen hazardous materials targeted for major usage reduction. Use of these materials should be minimized or eliminated unless needed to meet the requirements specified herein (see Section 3).

Table VII. EPA top seventeen hazardous materials.

Benzene	Dichloromethane	Tetrachloromethylene
Cadmium and Compounds	Lead and Compounds	Toluene
Carbon Tetrachloride	Mercury and Compounds	1, 1, 1 - Trichloroethane
Chloroform	Methyl Ethyl Ketone	Trichloroethylene
Chromium and Compounds	Methyl Isobutyl Ketone	Xylenes
Cyanide and Compounds	Nickel and Compounds	

6.10 Amendment notations. The margins of this specification are marked with vertical lines to indicate modifications generated by this amendment. This was done as a convenience only, and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations.

APPENDIX

Group Qualification by Characteristics

Previous revisions of this specification appendix employed a "group qualification" approach that identified for all possible switch types, the entirety of ways in which any given switch type could be qualified by previous qualification of other switch types with more rigorous requirement characteristics. A simplified approach is adopted herein to enable the same matrix of group qualification possibilities, without reiterating the entire list of switch characteristics combinations available to accomplish group qualification.

Group qualification is herein interpreted as "characteristics qualification". Switches with subordinate characteristics, that have all been qualified by previous qualification of the same or more rigorous dominant characteristics in earlier qualified switches, are considered qualified, with no additional testing. Group qualification by characteristics requires previous qualification of dominant characteristics covering subordinate characteristics in each of the following categories listed in table VII. Acceptance of group qualification by characteristics is at the discretion of the qualifying activity (Defense Supply Center Columbus, Code DSCC-VQE, P.O. Box 3990, Columbus, OH 43216-5000, vqe.chief@dla.mil).

The list of dominant switch qualification characteristics, listed by switch type, and associated lists of subordinate switch characteristics intended for group qualification by characteristics, follows:

TABLE VII. Characteristics for group qualification.

Category	Previous qualifying switch characteristic (dominant)	Switch characteristics (subordinate) qualified by group qualification
Switch type	Transfer (2P2T)	Transfer (2P2T)
Frequency range (GHz)	DC-40	DC-40, DC-26.5, DC-20, DC-18.5, DC-12.4, DC-10, DC-6, DC-0.4
Remote/Manual Operation	Remote - Fail-safe Remote - Latching Manual Remote - Fail-safe with logic control Remote - Latching with logic control	Remote - Fail-safe and latching; manual Remote - Latching and manual Manual Remote - Fail-safe and latching with and without logic control Remote - Latching with and without logic control
Indicating circuit	With indicator Without indicator	With and without indicator Without indicator
Screening	Screened Non-screened	Screened and non-screened Non-screened
Energizing voltage	28 V dc 115 V ac	28 V dc, 48 V dc, 110 V dc, 115 V ac 115 V ac
RF power level	High Standard	High and standard Standard
Seal	Hermetic Immersion Enclosed	Hermetic, immersion, enclosed, open Immersion, enclosed, open Enclosed and open

APPENDIX

TABLE VII. Characteristics for group qualification - Continued.

Category	Previous qualifying switch characteristic (dominant)	Switch characteristics (subordinate) qualified by group qualification
Switch type	1P10T	1P10T through 1P1T
Frequency range (GHz)	DC-40	DC-40, DC-26.5, DC-20, DC-18.5, DC-12.4, DC-10, DC-6, DC-0.4
Remote/manual operation	Remote - Fail-safe Remote - Latching Manual Remote - Fail-safe with logic control Remote - Latching with logic control	Remote - Fail-safe and latching; manual Remote - Latching and manual Manual Remote - Fail-safe and latching with and without logic control Remote - Latching with and without logic control
Indicating circuit	With indicator Without indicator	With and without indicator Without indicator
Screening	Screened Non-screened	Screened and non-screened Non-screened
Energizing voltage	28 V dc 115 V ac	28 V dc, 48 V dc, 110 V dc, 115 Vac 115 V ac
RF power level	High Standard	High and standard Standard
Seal	Hermetic Immersion Enclosed	Hermetic, immersion, enclosed, open Immersion, enclosed, open Enclosed and open

Custodians:
 Army - CR
 Navy - EC
 Air Force - 11
 DLA - CC

Preparing activity:
 DLA - CC
 (Project 5985-1290)

Review activities:
 Army - AV, MI
 Navy - AS, MC, OS
 Air Force - 19

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at www.dodssp.daps.mil.